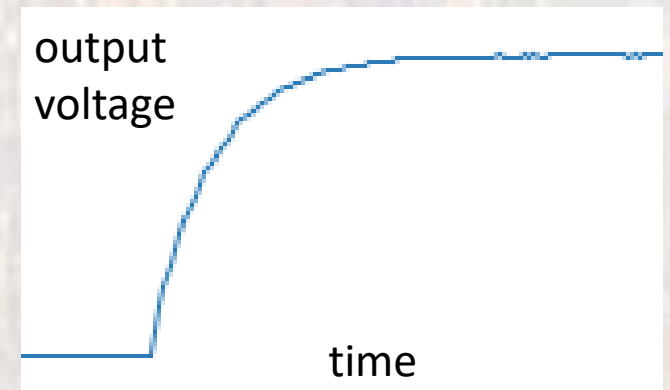
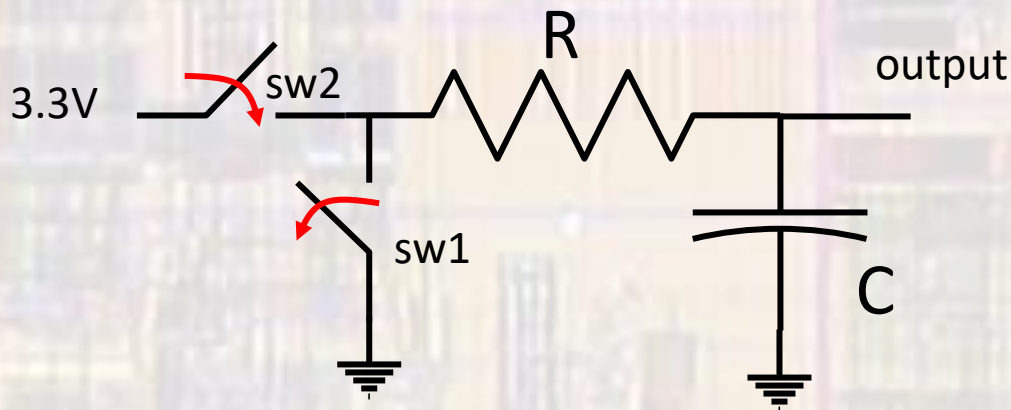


RC Circuits

Last updated 7/20/21

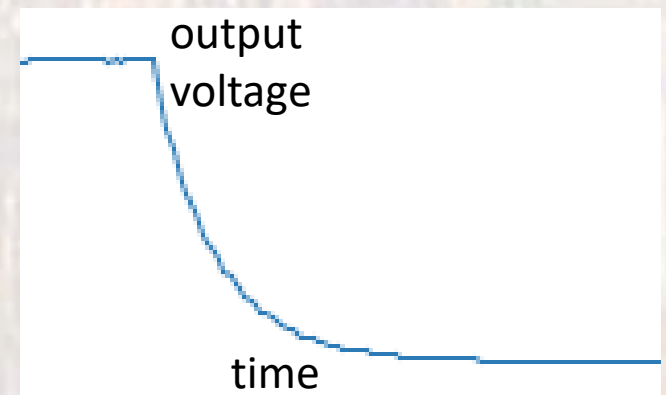
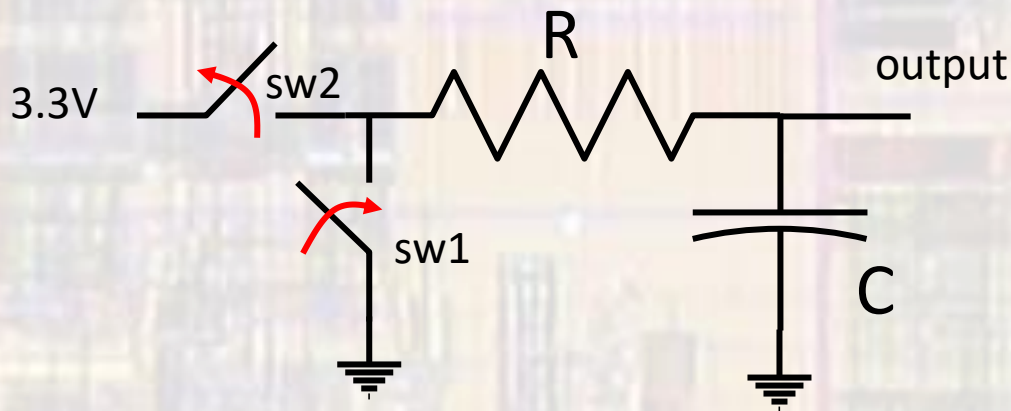
RC Circuits

- RC circuit switching
 - If we assume switch 1 has been closed for a very long time (sw2 open) – the output should be at 0v
 - When we open switch 1 and close switch 2 the resistor tries to pull the output up to 3.3V - but the capacitor limits how fast it can rise



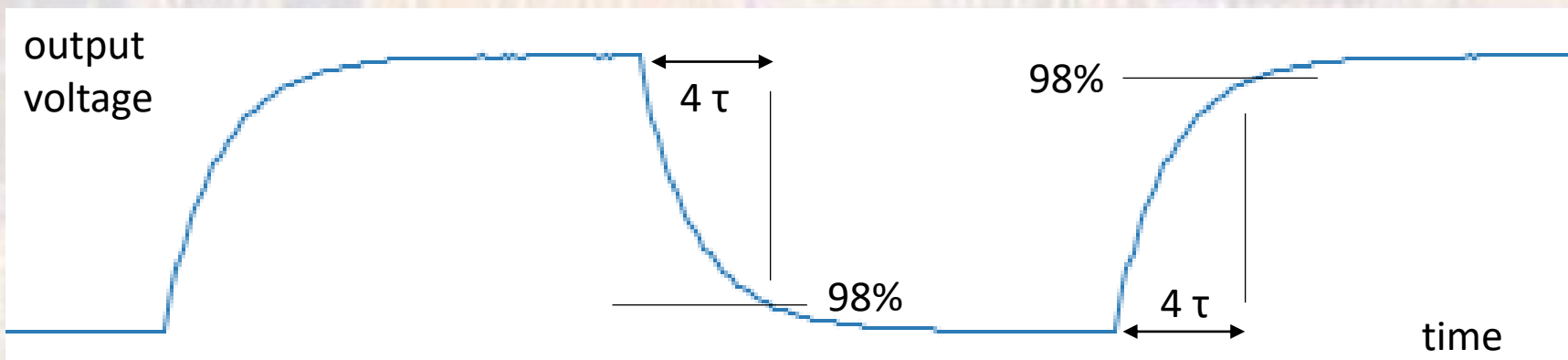
RC Circuits

- RC circuit switching
 - If we assume switch 2 has been closed for a very long time (sw1 open) – the output should be at 3.3v
 - When we open switch 2 and close switch 1 the resistor tries to pull the output down to gnd - but the capacitor limits how fast it can fall



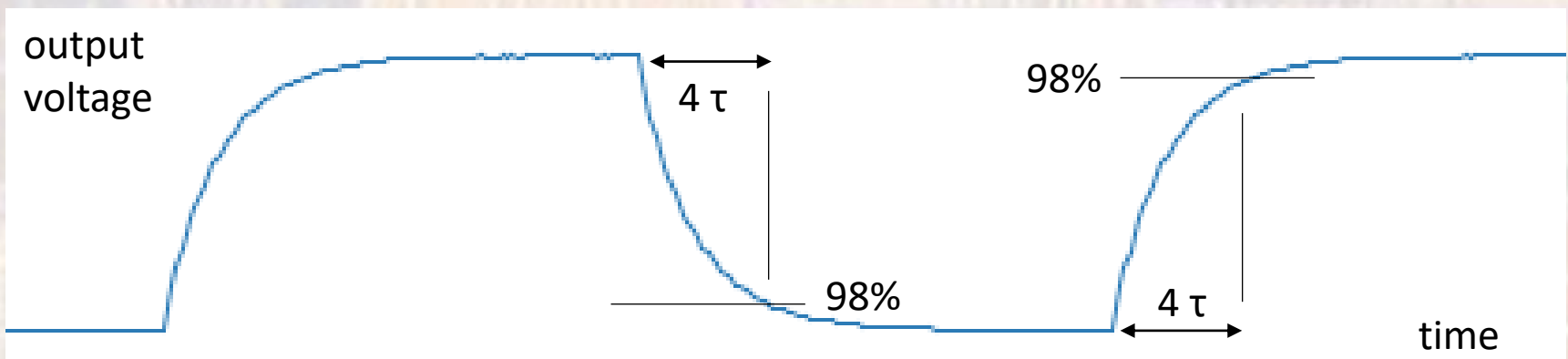
RC Circuits

- RC circuit time constant
 - The rise (charge) and fall (discharge) times are a function of the RC product, which is called the RC Time Constant and uses the symbol τ (tau)
 - $\tau = R \times C$
 - It takes approximately 4 time constants for the output to reach 98% of its final change in value



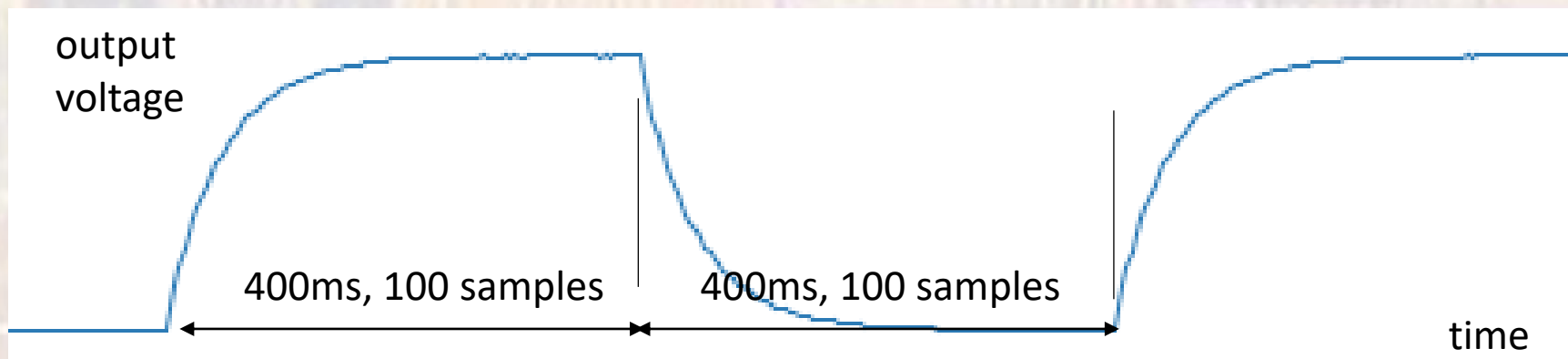
RC Circuits

- RC circuit time constant
 - For our circuit we will use a $10\text{K}\Omega$ resistor and a $4.7\mu\text{F}$ capacitor
 - $\tau = 10\text{K}\Omega \times 4.7\mu\text{F} = 47 \times 10^{-3} \Omega\text{-F} = 47\text{ms}$
 - $4\tau = 188\text{ms}$



RC Circuits

- RC circuit time constant
 - In order to ensure we can see the whole waveform we will use a total time of 400ms
 - With 100 samples \rightarrow 4ms delay between each sample



RC Circuits

- RC circuit – input control
 - We cannot control the timing of switches well enough to do this by hand
 - Use our controller to force the input high and low
 - 1 pin as a digital output switching from high to low, or low to high
 - Emulates the switches (changes every 400ms)
 - 1 pin as an analog input, doing an analog read every 4ms – starting immediately after the digital output transition